What do we learn from Schumpeterian growth theory?

Aghion, Akcigit, & Howitt (Handbook of Economic Growth 2014)

Levi Crews (Chicago) January 2020

What is Schumpeterian growth theory?

- creative destruction: process by which new innovations replace older technologies
- Schumpeterian growth theory:
 - models of creative destruction
 - rich micro data
- characterized by competing externalities:
 - knowledge spillover effect: any new innovation raises productivity forever ("standing on the shoulders of giants")
 - business stealing effect: any new innovation destroys the rents of the previous innovator

- Household: mass L infinitely-lived, $U(C) \propto C$, discount rate ρ , supply labor to production or R&D
- **Production**: final good (numeraire) and intermediate good (one line)
 - final: competitive, $Y_t = A_t y_t^{\alpha}$
 - intermediate: Bertrand, $y_t = \ell_t$, but no notion of firm
- Innovation: with frontier quality A, new innovation is quality γA (γ > 1)
 ⇒ creative destruction
- **R&D**: z_t units labor \implies new innovation arrives at rate λz_t

- in-class: final goods used in intermediates production and R&D; labor only used in final goods
- **in-class**: continuum of product lines, unit-elastic demand for each
- Handbook: step-by-step (effects of competition)
- **Handbook**: firm = collection of product lines (firm dynamics)

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$$L = y + z$$

2 **Research-arbitrage**: equate returns to unit of labor over dt

$$\underbrace{w_k}_{\text{wage after }k \text{ steps}} = \lambda \underbrace{V_{k+1}}_{\substack{Vk+1\\(k+1)\text{th step}}}$$

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Value of innovation:

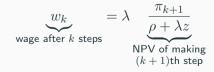
$$\rho V_{k+1} = \pi_{k+1} - \lambda z V_{k+1}$$

$$V_{k+1} = \frac{\pi_{k+1}}{\rho + \lambda z}$$

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Equilibrium profits:

• inverse demand curve:

$$p_k(y) = \frac{\partial (A_k y^{\alpha})}{\partial y} = A_k \alpha y^{\alpha - 1}$$

 $\bullet \ \text{profit max} \to \text{constant markup}$

$$\pi_{k} = \max_{y} \{ p_{k}(y)y - w_{k}y \}$$
$$\implies p_{k} = \frac{w_{k}}{\alpha}$$
$$\implies \pi_{k} = \left(\frac{1-\alpha}{\alpha}\right)w_{k}y$$

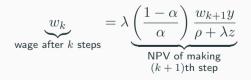
Balanced growth equilibrium: Two equations

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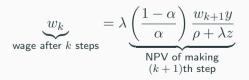
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Solve for equilibrium z:

- use (1), (2), and $w_{k+1} = \gamma w_k$
- equilibrium share of labor in R&D:



• positive R&D if
$$\left(\frac{1-\alpha}{\alpha}\right)\gamma L > \frac{\rho}{\lambda}$$

Equilibrium expected growth

• Recall:

- in interval [t, t + dt]: successful innovation w.p. $\lambda z dt$
- $Y_{k+1} = \gamma Y_k$
- So: expected log output is

$$\mathbb{E}\left[\ln Y_{t+dt}\right] = \lambda z dt \ln(\gamma Y_t) + (1 - \lambda z dt) \ln Y_t$$

• Expected growth rate:

$$\mathbb{E}[g_t] = \lim_{dt \to 0} \frac{\ln Y_{t+dt} - \ln Y_t}{dt} = \lambda z \ln \gamma$$

Share of labor in R&D:

$$\boxed{z = \frac{\frac{1-\alpha}{\alpha}\gamma L - \frac{\rho}{\lambda}}{1 + \frac{1-\alpha}{\alpha}\gamma}}$$

Expected growth rate:

$$\mathbb{E}[g_t] = \lambda z \ln \gamma$$

R&D and growth are increasing in ...

- λ : productivity of R&D tech.
- γ : step size of innovation
- *L*: population (scale effect)

R&D and growth are decreasing in \ldots

- α : elasticity of demand
- ρ : discount rate